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Managing the urban water-energy nexus

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Water use directly causes a significant amount of energy use in cities. In this paper we assess energy and greenhouse emissions related with each part of the urban water cycle and the consequences of several changes in residential water use for customers, water and energy utilities, and the environment.

First, we develop an hourly model of urban water uses by customer category including water-related energy consumption. Next, using real data from East Bay Municipal Utility District in California, we calibrate a model of the energy used in water supply, treatment, pumping and wastewater treatment by the utility. Then, using data from the California Independent System Operator, we obtain hourly costs of energy for the energy utility. Finally, and using emission factors reported by the energy utilities we estimate greenhouse gas emissions for the entire urban water cycle.

Results of the business-as-usual scenario show that water end uses account for almost 95% of all water-related energy use, but the 5% managed by the utility is still worth over $12 million annually. Several simulations analyze the potential benefits for water demand management actions showing that moving some water end-uses from peak to off-peak hours such as outdoor use, dishwasher or clothes washer use have large benefits for water and energy utilities, especially for locations with a high proportion of electric water heaters. Other interesting result is that under the current energy rate structures with low or no fixed charges, energy utilities burden most of the cost of the conservation actions.